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A MANUAL OF THE ECHINODERMS.

A Treatise on Zoology. Edited by E. Ray Lankester, F.R.S. Part iii. The Echinoderma. By F. A. Bather, J. W. Gregory and E. S. Goodrich. Pp. ix + 344. (London: A. and C. Black, 1900.)

THE first instalment of the long-expected "Oxford Zoology"—first, that is to say, in order of publication—will be heartily welcomed as filling a distinct gap in zoological literature, and not of this country alone. During the latter half of the nineteenth century scientific literature has accumulated with such rapidity as to render it practically impossible for a zoologist at the present day to master thoroughly more than a limited part of his subject. To acquire a knowledge of the results gained in fields other than that which he has made his speciality, he must be dependent to a large extent upon the manuals and guide-books compiled by those who are sufficiently familiar with the latest discoveries in particular branches of zoology to be able to give a clear and critical account of the present state of knowledge in these departments. Nowhere is this necessity more strongly felt than in dealing with the Echinoderms, a group in which the student is confronted, on the one hand, with intricate morphological problems and with phylogenetic questions of a most puzzling kind; and, on the other hand, with such a vast array of extinct types that the non-expert feels at once out of his depth when attempting to obtain an adequate knowledge of them. In the Pelmatozoa, practically half the phylum, we find a group of the greatest historical and phylogenetic importance, but one in which the existing forms teach us no more about the race in the past, and regarded as a whole, than do the modern Egyptians about the former dynasties whose remains are entombed in their land. The abundance of forms unearthed by the palæontologist has called forth a literature which exemplifies fully the danger of something like a deadlock in zoological science, as the result simply of its fertility. The student soon loses his way and finds himself struggling with a mass of hard facts and contradictory hypotheses, due on the one hand to the great diversity of form and structure in the objects themselves, and on the other hand to difficulties inseparable from the study of animals known almost entirely as fossils. Any one who has endeavoured, for instance, to gain an acquaintance with the structure and evolution of fossil Crinoids from the voluminous works of Messrs. Wachsmuth and Springer and other writers must have felt the urgent need for a guide and interpreter, failing whom it was necessary either to study deeply or to pass lightly by, to become an expert or to be content with ignorance. Yet no one with even a superficial acquaintance with the problems of Echinoderm morphology and phylogeny would willingly pass over the extinct forms, and least of all the more ancient Pelmatozoa, such as the Cystids and their allies, since it is obvious that here, if anywhere, is to be found in a concrete form the solution of many puzzles in the evolution of the phylum. Nowhere is palæontology, as a source of material evidence for theories of phylogeny, given so fair a trial as in the case of Echinoderms with their complete skeleton and consequent abundance of well-preserved fossil types, and it must be conceded that palæontology, if it condescends to speak clearly, can give the only final judgment in questions of evolution and ancestral history.

For many reasons, therefore, a plain and intelligible account of the Echinoderms, and especially of the Pelmatozoa, by those who have an expert knowledge of them, both as fossils and as recent forms, was greatly to be desired, and in the present volume we have the first complete treatise that has been published under these conditions in any language. The intention of the authors is to give a systematic account of the Echinoderms, including every known genus, living or extinct, and at the same time to trace as far as possible the evolution and relationships of the forms comprised under each class or order, as inferred both from their structural affinities and from their succession in time. The aim in view is therefore to effect a happy combination of the older styles of systematic treatise with the modern methods of comparative morphology, developmental history and phylogenetic speculation.

An introductory chapter, giving a general description of the organisation and development of Echinoderms, from the pen of Mr. Bather, attempts to trace the origin of the characteristic radiate symmetry from the bilateral ancestor represented by the Dipleurula larva. Like most other recent authorities on the group, Mr. Bather supports the opinion that the radiate symmetry was acquired in all Echinoderms during an ancestral fixed stage, in which the animal fed by means of currents produced by cilia and directed along special food-grooves towards the mouth. In all animals with this mode of nutrition, which was probably the primitive method in each of the principal phyla, except perhaps the Cnidaria and the Arthropods, the general tendency of evolution is towards a reduction or loss of active locomotion, and frequently towards fixation, which certainly occurred in the Echinoderms. The common ancestor of the phylum was, in fact, to all intents and purposes, a Pelmatozoon, fixed by the aboral pole, the original right side of the bilateral ancestor, and with ciliated grooves converging to the mouth on the upper side. Amongst the Cystids ancestral stages are to be found showing the gradual acquisition of a radiate pentamerous symmetry, first by the food-grooves and then by the skeleton and other organs of the body, last of all by the gonads. The Pelmatozoa retained permanently this mode of life, continually adapting and perfecting their organisation to the necessities entailed by it. The other Echinoderm classes, on the other hand, grouped together as Eleutherozoa, and including the modern starfishes, sea-urchins and holothurians must have become free again at a very early period after the acquisition of radiate symmetry, giving up their method of nutrition by means of ciliary currents, and losing in consequence their food-grooves, which atrophy as such, the condensation of the nerve-plexus at the base of the grooves persisting, and being further specialised as the "superficial" nervous system. The holothurians were the first stock to become Eleutherozoic, radiate symmetry in their case not having extended to the gonads, as it has in the case of the starfish and urchins.

The direct and positive evidence which is available may seem at first sight an insufficient foundation for the hypothesis of a Pelmatozoic ancestor of all Echinoderms, that is to say, a pre-Cambrian form in which the food-grooves initiated a radiate symmetry with which all other systems of organs gradually fell into line. But the necessity of some such assumption becomes irresistible when we realise by careful reflection the inadequacy of any other theory to account for the evolution of the characteristic radiate symmetry and the complete hold it has taken upon all organs of the echinoderm body. In the ontogeny of existing types it always seems as if it were the hydrocœle or water vascular system which actually set the tune to which all the other systems of organs dance, but it is difficult, if not impossible, to imagine clearly a course of ancestral evolution, limited and guided, as it must have been, by the necessities of the struggle for existence, in which the hydrocœle took the initiative in this respect, and did not itself follow the lead of some other system. The hydrocœle of the Pelmatozoic ancestor was probably at its first origin simply a compartment of the cœlom which had the function of furnishing tactile tentacles, formed as hollow outgrowths of the body-wall, in connection with the food-grooves. On this hypothesis it is easy to understand why the hydrocœle was the first system of organs to be affected by the radiate symmetry initiated by the primitive nutritive system, and consequently why, in the Eleutherozoa, after atrophy of the food-grooves, the symmetry should apparently start from the hydrocœle itself.

In the present volume the Pelmatozoa are also undertaken by Mr. Bather, who recognises four classes—Cystids, Blastoids, Crinoids and Edrioasterids. Another and perhaps more natural (*i.e.* phylogenetic) classification is hinted at (p. 39), but the arrangement quoted above is adopted as involving the least disturbance of established names and ideas. The Pelmatozoa occupy about two-thirds of the volume, and the treatment of this most difficult group cannot be too highly praised. An expert in this branch of zoology might perhaps find details to criticise or ideas with which to disagree ; the worker in other fields can only express his appreciation of the erudition displayed and the labour expended in setting forth the structure and evolution of this vast series of forms. In a group which is to a large extent represented by fossils, and in which so little material is available at the present day for the scalpel and the microtome, it is natural that less space and attention should be given to the anatomy and morphology of the soft tissues than to that of the skeleton and its never-ending complications of plates and ossicles. A simple Crinoid is taken as a type of Pelmatozoic organisation, and its anatomy is briefly described. One small point, at least, in this description is open to criticism. The author identifies Ludwig's blood-vessel and ring in the Crinoid as the "pseudhæmal," *i.e.* perihæmal, system (pp. 100 and 102). This seems to be an oversight, as elsewhere (p. 26) he states that this system "is so much reduced in Crinoidea that its existence is denied by some authors." Since the perihæmal system of canals, where well developed, as in the starfish, has been shown very clearly to be of cœlomic origin, it is impossible to identify with it the Crinoid "blood-vessel," which has all the characters of the canals termed in this work the "lacunar" or "hæmal" system. If anything in the Crinoid arm is to be identified as perihæmal (a term we much prefer to pseudhæmal), then probably the subtentacular canals have the most right to this title, as being cœlomic canals which occupy approximately the same position as the perihæmal canals in the starfish, and which have also the same relation to the lateral nerve cords that the perihæmal canals have to "Lange's nerves." On this view we should have to regard the perihæmal system as a portion of the cœlom, which in the Pelmatozoa has reached only an incipient degree of specialisation, being in the region of the disc completely merged in the general body-cavity.

The account of the Holothurians has been written by Mr. E. S. Goodrich, who gives a useful summary of our present knowledge of the group. The remaining Eleutherozoa—Stelleroidea and Echinoidea—have been undertaken by Prof. J. W. Gregory, whose researches on these groups are well known to zoologists, and who gives us a most valuable and complete account of them. It is necessary, however, to point out a few errors or oversights which have crept in, some of which are important, though they do not detract from the value of the work as a whole. On p. 261 it is pointed out that we are indebted to Sladen for a memoir on the aberrant form *Astrophiura*, and the work is quoted in due course amongst the literature of Stelleroidea, but nowhere else is any reference made to *Astrophiura* and its peculiarities ; it is omitted from the classification, does not appear in the index, and is, in fact, ignored altogether. The genus *Ophioteresis* is used as an argument for uniting the Asteroids and Ophiuroids on the ground that "the radial ambulacral vessels and nerve trunks lie in shallow grooves on the ventral surface of the anus" (p. 262 ; also pp. 270 and 274). The author gives no definite authority for this statement, but leaves us to infer that he obtains the fact from Bell's description of the genus. Bell, however, did not describe any such condition as that which Gregory dwells upon so often and makes the basis for such important deductions, and it is highly improbable that it occurs at all. It is much more probable the ambulacral vessels and nerve trunks pass in *Ophioteresis* through the aperture in the centre of the vertebral ossicle which Gregory figures plainly enough (Fig. xiv.), while maintaining a discreet silence about it. Finally, it must be mentioned that the peristomial plates in the Ophiuroid mouth skeleton are *not* "between the mouth frames and the buccal shields" (p. 264), but are above, *i.e.* to the aboral side of, the former, according, at least, to the careful descriptions and figures of Ludwig ; the "mouth frames" are between the buccal shields and the peristomial plates.

A conscientious reviewer does his best to find mistakes in the works submitted to his scrutiny and judgment. In the present instance it cannot be said that we have been very successful in our search, having regard to the size and scope of the work. In conclusion, we can but congratulate heartily the editor, authors and publishers on the very valuable treatise they have produced, a work which reflects credit on all concerned, and is a triumph for English zoology. E. A. M.